

The Office of Environment, Safety and Health and its Office of Nuclear and Facility Safety (NFS) publishes the Operating Experience Weekly Summary to promote safety throughout the Department of Energy (DOE) complex by encouraging feedback of operating experience and encouraging the exchange of information among DOE nuclear facilities.

The Weekly Summary should be processed as an external source of lessons-learned information as described in DOE-STD-7501-96, *Development of DOE Lessons Learned Programs*.

To issue the Weekly Summary in a timely manner, the Office of Operating Experience Analysis and Feedback (OEAF) relies on preliminary information such as daily operations reports, notification reports, and, time permitting, conversations with cognizant facility or DOE field office staff. If you have additional pertinent information or identify inaccurate statements in the summary, please bring this to the attention of Jim Snell, 301-903-4094, or Internet address jim.snell@hq.doe.gov, so we may issue a correction.

Readers are cautioned that review of the Weekly Summary should not be a substitute for a thorough review of the interim and final occurrence reports.

Operating Experience Weekly Summary 97-26

June 20 through June 26, 1997

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EVENTS

1. CRITICALITY ACCIDENT ALARM SYSTEM EVACUATION AREA PROBLEMS

This week, Operating Experience Analysis and Feedback engineers reviewed two events at the Oak Ridge Y-12 Site regarding problems associated with criticality accident alarm system coverage and evacuation areas. In the first event, facility engineers reviewed current drawings for criticality accident alarm system zone coverage and noticed inconsistencies in identifying overlapping coverage zones in some buildings. This resulted in a potential unreviewed safety question. In the second event, a Control Center assistant incorrectly instructed an employee to remain in a building located in the coverage zone during a criticality accident alarm system test. The employee did not have a personal alarming radiation detection device and should have evacuated. This resulted in a violation of the building operational safety requirement. Failure to identify and understand evacuation areas for criticality accident alarm systems and audible alarm coverage can result in radiation exposures during an inadvertent criticality. (ORPS Reports ORO--LMES-Y12NUCLEAR-1997-0024 and 0025)

On June 13, 1997, engineers identified a potential as-found condition during a drawing review of a proposed change to building criticality accident alarm system zone coverage areas. The current drawing for the first building coverage zone did not include any portion of a nearby second building. The drawing for a third building indicated the criticality accident alarm system in the first building covers a small portion of the north-east corner of the second building. Engineers identified a similar problem with two other buildings. The facility manager posted all identified coverage areas to restrict personnel entry pending verification of audible alarm indicators. Figure 1-1 provides a simplified illustration of how the criticality accident alarm system evacuation area and the audible alarm coverage of one building can overlap an adjacent building. Personnel located in the cross-hatched area of Building B would be affected by alarms in Building A.

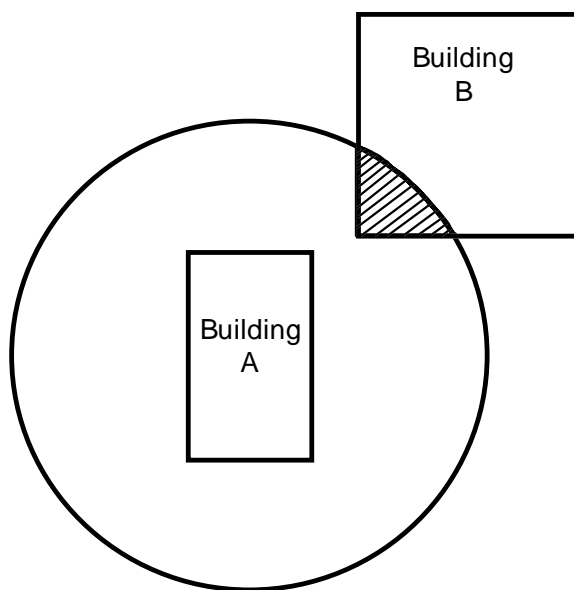


Figure 1-1. Area of Evacuation and Audible Alarm Coverage

On June 17, 1997, during a building criticality accident alarm test, an employee located in an office area of another building within the coverage zone did not evacuate as required. When the employee heard the emergency notification system announcement of the test, he called the Y-12 plant shift superintendent to request guidance. The Plant Shift Superintendent Control Center assistant erroneously instructed the employee not to evacuate and told him to remain in his work area. Test personnel successfully completed the surveillance test, and the employee suffered no effects. Investigators continue to determine the cause and the necessary corrective actions to prevent recurrence.

A similar event occurred at Y-12 on May 13, 1997, when four people did not have personal alarming radiation detection devices and did not evacuate during criticality accident alarm system testing. They were in a section of an adjacent building that was located within a 200-foot coverage area of the building under test. The individuals heard the public address system and emergency notification system announcement of the criticality accident alarm system test for the other building, but assumed they did not have to evacuate their building. (ORPS Report ORO--LMES-Y12NUCLEAR-1997-0021)

NFS reported criticality accident alarm system issues in Weekly Summaries 97-25, 97-18, 97-14, 96-38, 96-30, 96-27, 96-24, and 96-20. Weekly Summary 96-30 reported that on July 18, 1996, at the Rocky Flats Environmental Technical Site, criticality engineers discovered ten storage rooms that were neither analyzed for criticality detection and alarm capability nor equipped with required detectors and alarms. Fissile materials were stored in all of these rooms. Criticality engineers also discovered that there were no detector installation plans or drawings as required by American Nuclear Standard 8.1. (ORPS Report RFO--KHLL-SOLIDWST-1996-0106)

These events illustrate the importance of personnel clearly understanding criticality accident alarm system evacuation areas and audible alarm coverage. Facility managers should ensure that personnel working in buildings that contain alarm systems, or in adjacent buildings that fall within the alarm coverage area, can hear alarms and understand announcements that require evacuation.

DOE O 420.1, *Facility Safety*, provides direction for establishing nuclear criticality safety program requirements. The Order invokes several American National Standards (ANS) standards for design and operation of detecting systems, including ANS 8.1, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*, and ANS 8.3, *Criticality Accident Alarm System*. DOE-STD-1073-93, *Guide for Operational Configuration Management Programs, Including the Adjunct Programs of Design Reconstitution and Material Condition and Aging Management*, Parts 1 and 2, provides guidance on retention and control of documentation to confirm configuration of systems. Criticality safety managers at DOE facilities should review these documents and ensure that detection and alarm system requirements are adequate for personnel safety and drawings accurately reflect the actual system configuration

KEYWORDS: criticality safety, criticality alarm, operational safety requirement, configuration control

FUNCTIONAL AREAS: Nuclear/Criticality Safety, Configuration Control

2. MECHANICS WORK ON PUMP WITHOUT A LOCKOUT OR WORK PERMIT

On June 13, 1997, at the Savannah River Site, two maintenance mechanics worked on a pump without a lockout or a valid work clearance permit. They were determining why the pump did not provide flow during post-maintenance testing. After they removed the guard from the pump shaft and found the shaft binding, the mechanics disconnected the coupling to determine if the failure

was in the pump or in the bearing alignment. Maintenance mechanics had replaced the pump and removed the lockout a week earlier. While investigating the problem, mechanics used an expired work clearance permit that was valid only for the pump replacement. Although both mechanics verified the pump control switch was off, they should have verified the establishment of a lockout/tagout for the pump motor. Performing work on rotating equipment without isolating the energy source is dangerous and can result in injury or equipment damage. (ORPS Report SR--WSRC-HWFAC-1997-0003)

Between June 4 and 5, maintenance mechanics replaced the pump, but on June 12, operators did not see any flow during the pump post-maintenance testing. On June 13, the maintenance supervisor assigned two mechanics (one of whom had replaced the pump) to look at the pump to determine why it failed. The supervisor reminded the mechanics to sign the work clearance permit and informed them that work planners would revise the work package to re-work the pump. One mechanic signed the permit; however, he did not notice the permit was effective only for June 4 and 5. The other mechanic did not sign the permit because he had signed it on June 4, when it was issued. After working on the pump, the mechanics informed the supervisor that they believed a bearing was not aligned. Later that day, work planners revised the work package and work clearance permit, and the supervisor signed the permit and a lockout.

On June 16, the supervisor assigned two mechanics to troubleshoot the pump. The lockout was walked down by the mechanic who performed the work on June 13. The mechanics determined that the pump was bound up and they needed assistance from the pump vendor. On June 16, a facility evaluation board member reviewed the June 4 and 5 work clearance permit and the revised work clearance permit from June 12, and questioned the lack of a work clearance permit for uncoupling the pump.

The facility manager conducted a critique of the event. Critique members identified the following three causes for this event.

- Personnel error (communication problem) — The mechanic was not clear as to the intent of the supervisor's instructions to look at the pump.
- Personnel error (inattention to detail) — The mechanics were too engrossed in troubleshooting and did not recognize a lockout was required to uncouple the motor.
- Management problem (policy not adequately defined, disseminated, or enforced) — The mechanic signed the work clearance permit on June 4. However, he was not specifically required to review the work clearance permit on June 13, so he did not know it had not been extended.

Corrective actions included (1) issuing a lessons learned bulletin emphasizing the importance of verifying the work clearance permit and knowing the work scope boundaries and (2) performing an evaluation of the need for self-assessment on the use of work clearance permits.

NFS reported lockout/tagout events in Weekly Summaries 97-24, 97-03, 96-50, 96-35, 96-34, 96-33, 96-32, 96-27, 96-21, 96-11, 96-10, and 96-06. In Weekly Summary 97-24, Operating Experience Analysis and Feedback engineers reported that, based on a review of 1,462 lockout/tagout occurrences DOE-wide, 36 percent of the root causes were personnel error and 34 percent were management problems. Further review of the personnel errors showed that 44 percent were caused by inattention to detail and 43 percent by procedure not used or used incorrectly. A review of the management problems showed that 35 percent were caused by policy not adequately defined, disseminated, or enforced.

This event underscores the need for maintenance personnel to ensure that equipment is properly locked and tagged out before performing maintenance or troubleshooting activities. They should also ensure that the work is being performed in accordance with valid work control documents and permits. Maintenance personnel should understand that work scope boundaries (for example, the safety requirements for conducting a visual inspection of a pump) are not as rigorous as those for uncoupling or disassembly it. DOE-STD-1030-96, *Guide to Good Practices for Lockouts and Tagouts*, states that a lockout/tagout must isolate all sources of energy or hazardous materials that may cause injury or equipment damage. Isolating a pump motor for bearing maintenance, for example, should also include shutting and tagging pump suction and isolation valves to prevent possible rotation from fluid flow. A copy of the standard is available on the Department of Energy Technical Standards Home Page at URL <http://www.doe.gov/html/techstds/standard/standard.html>.

Facility managers should review DOE/EH-0540, Safety Notice No. 96-05, "Lockout/Tagout Programs." The notice summarizes lockout/tagout events at DOE facilities, provides lessons learned and recommended practices, and identifies lockout/tagout program requirements. The section on "Significance of Events," states that there were 2 deaths, 1,661 lost work days, and more than \$3.5 million in property damage reported in the Computerized Accident/Incident Reporting System. The Department of Labor estimates that compliance with the lockout/tagout standards in 29 CFR 1910.147 would prevent about 120 fatalities, 28,000 serious injuries, and 32,000 minor injuries each year. Safety Notice 96-05 can be obtained by contacting the Info Center, (301) 903-0449, or by writing to ES&H Information Center, U.S. Department of Energy, EH-72/Suite 100, CXXI/3, Germantown, MD 20874. Safety Notices are also available on the Operating Experience Analysis and Feedback Home Page at http://tis.eh.doe.gov:80/web/oeaf/lessons_learned/ons/ons.html. The *Hazard and Barrier Analysis Guide*, developed by the Office of Operating Experience Analysis and Feedback, includes a hazard-barrier matrix that shows the lockout/tagout as the most effective barrier against injury. When implemented properly, lockout/tagout provides a high probability (greater than 99 percent) of success for risk reduction. A copy the guide is available from Jim Snell, (301) 903-4094, or by contacting the Info Center.

KEYWORDS: lockout and tagout, maintenance, pump, work clearance

FUNCTIONAL AREAS: Mechanical Maintenance

3. LOSS OF AIR TO FULL-FACE RESPIRATOR

On June 6, 1997, at the Rocky Flats Environmental Technology Site, an operator lost the hose-fed air supply to her full-face respirator while working on decontamination activities. The operator had been working inside the housing for approximately 15 minutes when the supply failed. When the operator activated the emergency air bottle, she assumed it failed, because she was not getting any air flow. The operator's respirator contained a breathing air adapter and a High Efficiency Particulate Absorber (HEPA) filter that supplied air for her plastic suit. The operator then started to breathe through the HEPA filter, avoiding potential contamination. There was no contamination on the worker's inner anti-contamination clothing, and nasal smears showed no signs of contamination. (ORPS Report RFO--KHLL-371OPS-1997-0048)

The operator was able to breathe through the HEPA filter by inhaling and exhaling deeply. This method of breathing provides approximately 15 minutes worth of air. However, breathing is difficult because the operator must overcome spring tension in a check valve that is on the breathing air adapter. During the investigation, instructors stated that employees are trained to

disconnect from supplied air, breathe the room air, and exit the area. The operator stated that she felt it was safer to breathe HEPA filtered air while exiting the area than to disconnect and breathe highly contaminated room air.

The facility manager held a fact-finding meeting with all personnel involved. Industrial Hygiene and Safety representatives initially suspended the use of supplied air. Plant representatives met with the supplied-breathing-air manufacturer and failed to identify an exact cause of the failure. Although the specific cause of the failure remains unidentified, investigators believe that the face-piece regulator malfunctioned. The manufacturer and site subject matter experts will also conduct a system inspection. Investigators also determined that the emergency air did not fail. The emergency air could not overcome the pressure that was set for the primary air. Future mock-up training and qualification will include an accident scenario addressing loss of primary supplied air to the respirator while maintaining primary air to the garment. However, facility representatives stated that it is not clear if this training will be implemented site-wide.

NFS has reported a variety of problems associated with breathing air systems across the DOE complex. Examples include (1) hose connector separations, (2) problems with quick disconnects, (3) non-certified respirator parts, (4) fixed contamination on respirators, (5) separation of mask-mounted regulators, (6) personnel not properly wearing respirators, and (7) isolating breathing air to perform maintenance on other equipment.

NFS reported problems with breathing air in Weekly Summaries 96-52, 95-36, and 95-10.

- On December 11, 1996, at Savannah River, a laboratory technical area facility manager reported that workers used a breathing air manifold that did not have a flow restrictor as required. Failing to use the correct breathing air equipment created the potential for an uptake. (ORPS Report SR--WSRC-LTA-1996-0041)
- On August 24, 1995, at Rocky Flats, maintenance personnel discovered deficiencies with crimped fittings and failed leak tests in four air-line hoses before entering a plutonium component storage area. Investigations led to discontinuing use of air-line hoses that were manufactured before improvements in the suppliers program and highlighting the need for improved control of supplied hoses. (ORPS Report RFO--KHLL-PUFAB-1995-0018)
- On February 27, 1995, at Savannah River, three workers lost breathing air while working in plastic bubble suits in an airborne radiological contamination area. The loss of air occurred when a construction worker turned off the breathing air compressor at the end of the shift. The workers were not injured and did not ingest radioactive material. (ORPS Report SR--WSRC-HTANK-1995-0011)

This event highlights the importance of clear thinking, good communications, and teamwork. Personnel responsible for respiratory protection at other DOE facilities should review the lessons learned from this event for applicability. DOE O 5480.19, *Conduct of Operations Requirement for DOE Facilities*, provides guidelines for communications, safety practices, and training. Chapter I of the Order states: "a high level of performance in DOE facility operations is achieved through effective implementation and control of operations activities. Operations activities should recognize that environment, safety, and productivity are compatible goals." DOE Order 5480.4, *"Environmental Protection, Safety, and Health Protection Standards,"* mandates the requirements contained in American National Standards Institute Standard Z88.2, *"Practices for Respiratory Protection,"* and 29 CFR 1910.134 for implementation of the Respiratory Protection Program and associated training of personnel.

DOE/EH-0256T, *U.S. Department of Energy Radiological Control Manual*, Chapter 6, provides guidance on training and qualification for radiological workers, including anticipated response to abnormal situations. DOE facilities should review their work processes to assure that all steps required to assure worker safety are included in written procedures. Training personnel at DOE facilities should review their training programs to ensure that they include simulated response to abnormal situations, such as loss of breathing air in respiratory training.

DOE-STD-012T, *Performance-Based Training Manual*, contains narrative procedures on performance-based training that can be modified and incorporated as appropriate for facility-specific application. The standard discusses developing training programs that ensure the training is conducted efficiently, effectively, and directly relates to job requirements. Guidance is provided to assess training needs, design development, and implementation to evaluate training effectiveness. Facility managers and training managers should review this standard when developing or revising training.

KEYWORDS: air, respirator, self-contained breathing apparatus

FUNCTIONAL AREAS: Industrial Safety, Radiation Protection, Lessons Learned

4. **SUBCONTRACTOR OPERATES TRACK HOE NEAR 480-VOLT POWER LINE**

On June 18, 1997, at the Fernald Environmental Management Project, construction subcontractors performing earth-work activities positioned the boom of a track hoe within 1 foot of an overhead 480-volt power line in violation of Occupational Safety and Health Administration (OSHA) regulations and site procedures. Investigators discovered that the 480-volt line had been locked and tagged out for a different project and was not energized. However, the operator and the field superintendent performing the earth-work activities had not signed in on the lockout-tagout. Therefore, they were not aware that the line was de-energized. The lockout-tagout could have been cleared without the subcontractors knowledge. Failure to follow procedures and oral instructions can result in personal injury or damage to equipment. (ORPS Report OH-FN-FDF-FEMP-1997-0036)

Investigators determined that the site construction coordinator realized that the track hoe boom could come within 10 feet of the power line. He informed the subcontractor field superintendent and subcontractor construction manager of the problem. The construction manager instructed the coordinator to tell the field superintendent to stop work. The coordinator relayed the message to the field superintendent, but work continued. The construction manager then radioed the field superintendent and told him to stop work. The field superintendent told him that they were finishing the work and it would be completed by the time the construction manager arrived. The operator finished the job before moving the track hoe away from the power lines.

Facility representatives stated that the pre-job brief had focused on radiological controls. They believe that the subcontractors' inexperience with the nuclear aspects of the job, combined with the pre-job brief, made them attentive to the radiological aspects of the job and led them to neglect other job aspects.

NFS reported similar events involving energized lines or conduits and the failure to recognize and respond to hazards in Weekly Summaries 97-02, 96-49, and 96-26.

- On December 31, 1996, at Savannah River, an operator inadvertently backed a front-end loader into a guy wire causing it to break. The cut wire contacted a 13.8-kV transformer short-circuiting it. Investigators determined that the work package

did not address safe working distances from wires and that a spotter was not used during this activity. (ORPS Report SR--WSRC-SLDHSD-1996-0029)

- On November 22, 1996, at Argonne National Laboratory—East, a dump truck with the truck box raised snagged an overhead 120/240-volt power line and communication lines while leaving the dump site. Investigators determined that the Construction Job-Specific Requirements form did not indicate an overhead line hazard and that spotters were not used. Corrective actions included modifying the form to include a review for overhead lines and designating a spotter. (ORPS Report CH-AA-ANLE-ANLEPFS-1996-0009)
- On June 16, 1996, at Yucca Mountain, an electrician removed a tag and energized a padmount transformer without authorization. The line had been energized for 7 days before the chief power dispatcher learned about the unauthorized switching operation. The energized power line represented a hazard and placed personnel at risk because they believed the line was still de-energized. (ORPS Reports HQ--SAYM-YMSGD-1996-0005 and NVOO--BNOO-NTS-1996-0010)

Operating Experience Analysis and Feedback (OEAF) engineers reviewed the Occurrence Reporting and Processing System (ORPS) database and found 383 final reports associated with construction activities and the failure to follow procedures. Figure 4-1 shows the distribution of root causes reported by facility managers for these events DOE-wide from 1990 to present. Personnel errors represented 47 percent of the root causes, and management problems represented 44 percent. Further review of personnel errors shows that 76 percent were caused by procedure not used or used incorrectly; 35 percent of the management problems were caused by policy not adequately defined, disseminated, or enforced.

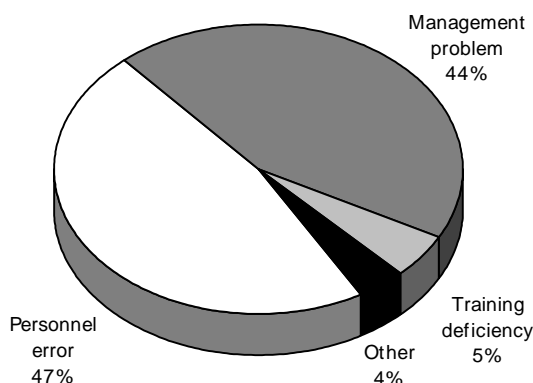


Figure 4-1. Distribution of Root Causes for Failing to Follow Procedures¹

These events demonstrate the importance of exercising extreme caution when operating cranes, front-end loaders, forklifts, and other vehicles in the vicinity of guy wires, power lines, and switchyards. Pre-job briefings, facility procedures, and training programs should emphasize the dangers associated with these types of operations. Many events have occurred while personnel were backing up motive units, indicating that operators of equipment must be aware of hazards in all directions, including above them. DOE 4330.4B, *Maintenance Management Program*, section

¹ OEAF engineers screened the ORPS database for direct cause codes "3b" (procedure not used or used incorrectly) and activity category "1" (construction) from 1990 to present and found 383 occurrence reports.

8.3.1, provides guidelines on work control systems and procedures. The Order requires control procedures to help personnel understand the requirements for working safely. DOE 5480.19, *Conduct of Operations Requirements for DOE Facilities*, provides guidance on how to assure effective communications in an operating facility.

OSHA regulation 29 CFR 1926.416(g)(2)(iii), "Overhead Lines," states that any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines shall be operated so that a clearance of 10 feet (305 cm) is maintained. Managers at DOE facilities should review their programs to ensure that subcontractors understand their responsibilities and obligations and that personnel understand the basics of work control practices, work planning, and safety and health hazards.

KEYWORDS: occupational safety, lockout and tagout, energized equipment

FUNCTIONAL AREAS: Industrial Safety, Work Planning

OEAF ACTIVITY

1. SAFETY NOTICE ON MIXING AND STORING INCOMPATIBLE CHEMICALS

Historically, DOE has used numerous chemicals in a variety of missions. These range from common acids, bases, and oxidizing agents; to specialty organics, explosives, and hydrocarbon fuels; to toxic, corrosive, or flammable gases. There have been some significant events recently involving unexpected chemical reactions. In OE Weekly Summary 97-21, Operating Experience Analysis and Feedback (OEAF) engineers reported on a chemical explosion at the Hanford Plutonium Reclamation Facility. OE Weekly Summary 97-22 reported the rapid overpressurization of a waste shipping container at Fernald. Both of these events are still under investigation. However, because of the significance of these events, and the potential that similar conditions may exist at other DOE facilities, the Office of Nuclear and Facility is issuing a safety notice addressing the consequences of mixing and storing incompatible chemicals. The safety notice is available through the OEAF Home Page. The URL for the home page is http://tis.eh.doe.gov:80/web/oeaf/oe_analysis.html. For direct access use http://tis.eh.doe.gov:80/web/oeaf/lessons_learned/ons/sn9701.html.